AMERICAN JOURNAL OF INDUSTRIAL MEDICINE 35:76–81 (1999)

Occupation and Pancreatic Cancer Risk in Shanghai, China

Bu-Tian Ji, MD, DrPH,[1,2]* Debra T. Silverman, ScD,[1] Mustafa Dosemeci, PhD,[1] Qi Dai, MD,[2] Yu-Tang Gao, MD,[2] and Aaron Blair, PhD[1]

Background *Any association between occupation and pancreatic cancer risk has not been conclusively demonstrated. A population-based case-control study was conducted to examine occupational risks of pancreatic cancer in Shanghai, China.*

Methods *The study included 451 pancreatic cancer patients newly diagnosed in 1990–1993 and 1,552 controls randomly selected from Shanghai residents. Information on a lifetime job history and other factors was obtained in a face-to-face interview.*

Results *Among men, an increased risk of pancreatic cancer was associated with employment as an electrician (OR = 7.5, CI = 2.6–21.8), and a positive trend in risk with increasing duration of employment was apparent (P for trend = 0.0003). Exposure to electric magnetic fields (EMF) as measured by a job exposure matrix also was associated with an increased risk among electricians. Threefold risks were observed for men with the highest level of intensity and for those with the highest probability of EMF exposure, although women with heavy EMF exposure did not experience increased risk. Among men, elevated risks also were found for metal workers (OR = 2.1, CI = 1.0–4.8); toolmakers (OR = 3.4, CI = 1.4–7.1); plumbers and welders (OR = 3.0, CI = 1.2–7.5); and glass manufacturers, potters, painters, and construction workers (OR = 2.6, CI = 1.1–6.3). Among women, textile workers experienced an increased risk (OR = 1.4, CI = 0.8–2.6).*

Conclusions *Our results suggest that occupations associated with exposures to metal and textile dusts or certain chemicals may increase the risk of pancreatic cancer. The elevated risk among electricians may warrant further study to evaluate the possible role of EMF or other exposures.* Am. J. Ind. Med. 35:76–81, 1999. *Published 1999 Wiley-Liss, Inc.*†

KEY WORDS: case-control study; epidemiology; occupation; pancreatic cancer; electrical work; job exposure matrix

INTRODUCTION

Pancreatic cancer is a rapidly fatal malignancy. The etiology of the disease is largely unknown, except for smoking, which has been consistently associated with risk of pancreatic cancer [IARC, 1986; Howe et al., 1991; Silverman et al., 1994]. Excess risks of pancreatic cancer have been noted among workers in numerous epidemiologic studies, but the evidence linking work-related exposures to this malignancy is inconsistent [Mack et al., 1985; Anderson et al., 1996]. At least 40 industries and/or occupations have been reported to be related to pancreatic cancer risks in different areas and countries [Partanen et al., 1994], with the most frequently reported excesses in the chemical and petroleum industries and in metallurgy workers [Pietri and Clavel, 1991].

A large population-based case-control study conducted in Shanghai provided an opportunity to assess risk of pancreatic cancer among workers in Shanghai. In previously

[1]Division of Cancer Epidemiology and Genetics, National Cancer Institute, Bethesda, MD

[2]Department of Epidemiology, Shanghai Cancer Institute, Shanghai, People's Republic of China

*Correspondence to: Dr. Bu-Tian Ji, National Cancer Institute, 6130 Executive Blvd., EPN 415, Rockville, MD 20852. E-mail: jib@exchange.nih.gov

Accepted 2 September 1998

published papers from this study, we have reported that elevated risks for pancreatic cancer were associated with cigarette smoking [Ji et al., 1995a], infrequent consumption of fresh vegetables and fruits [Ji et al., 1995b], and increasing number of pregnancies or live births [Ji et al., 1996]. In this report, we present the risks of pancreatic cancer associated with usual occupation and specific exposures as determined by a job exposure matrix (JEM).

MATERIALS AND METHODS

Methods used to conduct this population-based case-control study of gastrointestinal cancers (pancreas, esophagus, colon, and rectum) have been described in detail elsewhere [Ji et al., 1995a]. Briefly, all eligible pancreatic cancer patients who were aged 30–74 years and newly diagnosed between October 1, 1990, and June 30, 1993, were identified through a rapid reporting system established by Shanghai Cancer Registry. Of the 577 eligible patients, 451 (78.2%) were interviewed. Study cases were confirmed by histopathology (37%), surgery with gross but not microscopic pathology (20%), or computed tomography scan/ultrasound (43%). We excluded 109 cases who died before the interview could be conducted, 11 who could not be located, and 6 who refused an interview.

Controls were randomly selected from residents of urban Shanghai and frequency-matched to the expected age (5-year categories) and gender distribution of incident pancreatic cancer cases and cases of three other gastrointestinal malignancies included in the overall study. Of the 1,552 controls eligible for study, 84.5% agreed to participate. For those who moved away or refused participation (n = 240), we obtained an interview from an alternate.

Each subject was interviewed in person by a trained interviewer, using a structured questionnaire to elicit information on demographic and residential characteristics, diet, cigarette smoking, alcohol, and other beverage consumption, medical history and family cancer history, physical activity and lifetime occupational history. Each job title was coded by a 3-digit number according to the standardized coding scheme developed for the data of the Third National Census in 1982 [National Bureau of Statistics, 1982]. The risk of pancreatic cancer was estimated for the usual occupation (i.e., longest held occupation). For analytic purposes, job titles were initially examined based on 2-digit subcategories, then risks were estimated for all three-digit subcategories in which there were sufficient number of subjects for analysis. Risks for certain high-risk occupations were further assessed by estimation of risk by duration of employment.

Four job exposure matrices (JEMs) were available for analysis of risk by specific work-related exposures in this population (i.e., pesticides, electromagnetic fields [EMF], benzene, and solvents), with indices of intensity and probability. Each 3-digit occupation and industry code was scored according to level (i.e., 0 = none, 1 = low, 2 = medium, and 3 = high) of exposure to each of these four occupational hazards. Average lifetime cumulative scores of intensity and probability of exposure were calculated by dividing lifetime cumulative measures from the JEM by total years of exposure for each individual. The final scores were re-categorized into four levels (i.e., none = 0, low = 1–2, medium = 3–5, high = 6–9) [Dosemeci et al., 1989].

Odds ratios (ORs) and 95% confidence intervals (CIs) were estimated by unconditional logistic regression. Categorical variables for JEM scores and duration of employment in high-risk occupations were entered as continuous variables in the logistic regression models to test for linear trend. Since there were very different distributions of occupations held between men and women, the ORs were calculated separately for each. The following potential confounders were included in the models: age, education, per capita familial income, cigarette smoking, and other high-risk occupations. Other risk factors previously reported, such as dietary factors (fresh vegetables and fruits), number of pregnancies and live births, and body mass index [Ji et al., 1995, 1996], were also included in the analyses, but the associations with occupations and EMF exposure were not altered materially after adjustment for these risk factors.

RESULTS

Compared with controls, patients tended to be older (median age of 63 years for cases vs. 62 years for controls among men and 65 years vs. 61 years among women), to have higher monthly income (median family per capita income [yuan/month] was 43 vs. 39 among men and 43 vs. 34 among women), and to be more educated (16.3% of cases v. 14.6% of controls with 13+ years of schooling among men and 8.6% vs. 6.3% among women). In addition, more cases were smokers than controls (74% vs. 66% among men and 18% vs. 13% among women) (data not shown).

A significant excess risk of pancreatic cancer was associated with employment as an electrical fitter and related electrical and electronic worker (OR = 6.2, CI = 2.4–16.4) among men (Table I), and the OR was 7.5 (CI = 2.6–21.8) among men who worked as an electrician per se. Excess risks also were found among men who were employed as a toolmaker (OR = 3.2, CI = 1.4–7.1); metal worker (OR = 2.1, CI = 1.0–4.8); plumber and welder (OR = 3.0, CI = 1.2–7.5); and glass manufacturer, potter, painter, and construction worker (mostly exposed to dusts) (OR = 2.6, CI = 1.1–6.3) (Table I). Non-significant excesses among men were observed for teachers, cooks, and dockyard workers and freight handlers. No statistically significant ORs were observed among women, but elevations were observed among economists and financial planners; rubber workers; textile workers; toolmakers; plumbers and welders; dock-

TABLE I. Odds Ratios (ORs) and 95% Confidence Intervals (CIs) for Pancreatic Cancer by Selected Occupational Subcategories and Sex, Shanghai, China, 1990–1993*

	Men		Women	
Occupation (code)	Case/control (260/845)	OR (95% CI)	Case/control (186/696)	OR (95% CI)
Technician (031-049)	10/28	1.5 (0.6–4.0)	2/7	1.5 (0.3–8.2)
Economist and financial planner (091-099)	13/60	0.9 (0.4–2.2)	9/35	1.9 (0.8–4.5)
Teacher (111-119)	12/32	1.8 (0.7–4.4)	6/40	0.7 (0.3–2.0)
Salesperson, shop assistant (411-499)	12/45	1.2 (0.5–2.9)	6/24	1.2 (0.4–3.5)
Cook (530)	8/11	2.3 (0.6–8.5)	3/19	0.6 (0.1–2.7)
Metal worker (721-729)	12/34	2.1 (1.0–4.8)	2/11	0.9 (0.2–4.6)
Chemical and rubber worker (731-749)	1/17	0[a]	5/14	1.4 (0.4–4.7)
Rubber worker (741-749)	0/7	0[a]	5/10	1.7 (0.5–5.8)
Textile worker (751-759)	4/26	0.4 (0.1–1.7)	26/71	1.4 (0.8–2.6)
Printer or related worker (821-829)	4/5	5.2 (1.1–25.0)	0/4	0[a]
Blacksmith, toolmaker, and machine-tool operator (841-849)	22/46	2.0 (1.0–4.0)	6/17	1.8 (0.6–5.3)
Toolmaker (842)	16/22	3.2 (1.4–7.1)	2/0	[a]
Electrical fitter and related electrical and electronic worker (861-869)	12/16	6.2 (2.4–16.4)	2/17	0.5 (0.1–2.6)
Electrician (864)	11/11	7.5 (2.6–21.8)	0/3	0[a]
Plumber, welder (881-884)	10/19	3.0 (1.2–7.5)	4/9	1.8 (0.5–6.4)
Glass manufacturer, potter, and construction worker (891-929)	10/28	2.6 (1.1–6.3)	4/28	0.6 (0.2–1.9)
Dockyard worker and freight handler (941-949)	13/47	1.6 (0.7–3.7)	6/13	2.0 (0.7–5.9)
Transportation equipment operator (951-959)	10/33	1.1 (0.4–2.9)	3/13	0.9 (0.2–3.5)
Inspector and product analyst (961-964)	1/16	0[a]	7/19	1.6 (0.6–4.5)

*Odds ratios adjusted for age, education, income, cigarette smoking, and other occupations.
[a]Insufficient number of subjects.

yard workers and freight handlers; and inspectors and product analysts.

Trends by duration of employment are shown in Table II. Among men, a significant trend in risk with increasing of years of employment as an electrician was apparent (P = 0.0003). Compared to non-electricians, the ORs were 6.3 (CI = 1.6–25.4) and 9.3 (CI = 2.0–43.8) for those who worked <35 and 35+ years. Duration-response relationships also were found for metal workers; toolmakers; plumbers and welders; and glass manufacturers, potters, and construction workers, but the trends for metal workers, and plumbers and welders were not statistically significant. Among women, consistent, but not significant, dose-response relationships were observed for workers employed as economists and financial planners, textile workers, inspectors, and product analysts.

To further examine the association between electrical workers and risk of pancreatic cancer, a JEM for EMF exposure was examined. Significant trends in risk by intensity and probability of JEM-EMF exposure were apparent for male electrical workers (Table III). A threefold risk was associated with high intensity (OR = 3.3, CI = 1.4–7.9) and with high probability of exposure to EMF (OR = 2.6, CI = 1.2–5.4). No association was found with EMF exposure among women, however. Other exposures based on JEM scores to pesticides, benzene, and solvents were not linked to risks of pancreatic cancer among either men or women in our study.

DISCUSSION

Our case-control study is the first to evaluate the relationship between occupation and pancreatic cancer risk in China. Among men, increased risks of pancreatic cancer were seen for electricians; metal workers; toolmakers; plumbers and welders; and glass manufacturers, potters, painters, and construction workers. Among women, elevated risks were observed for textile workers and economists and financial planners.

The most consistent finding in our study was the positive association between employment as an electrician and pancreatic cancer. Over a 7-fold overall risk was observed and the OR rose to 9.3 for subjects with more than 35 years of employment among men. In addition, intensity and probability of EMF exposure, as estimated by a JEM, were associated with risk. However, no such consistent

TABLE II. Odds Ratios (ORs) and 95% Confidence Intervals (CIs) for Pancreatic Cancer by Working Years of Selected Occupational Subcategories Among Men and Women, Shanghai, China, 1990–1993*

	Years of working			*P* for
Occupation (code)	**0**	**<35**	**35+**	**trend**
Men				
Metal worker (721-729)				
Ca/Co	248/811	7/27	5/7	
OR (CI)	1.0	1.8 (0.7–4.7)	3.1 (0.8–11.5)	0.06
Toolmaker (842)				
Ca/Co	244/842	10/10	6/12	
OR (CI)	1.0	3.2 (1.1–9.3)	3.1 (1.0–9.4)	0.01
Plumber, welder (881-884)				
Ca/Co	250/826	7/13	3/6	
OR (CI)	1.0	3.6 (1.2–10.4)	2.1 (0.5–9.5)	0.06
Glass manufacturer, potter, and construction worker (891-929)				
Ca/Co	250/817	7/18	3/10	
OR (CI)	1.0	2.5 (0.9–6.8)	3.0 (0.7–13.8)	0.04
Electrician (864)				
Ca/Co	249/834	6/6	5/5	
OR (CI)	1.0	6.3 (1.6–25.4)	9.3 (2.0–43.8)	0.0003

	Years of working			*P* for
Occupation (code)	**0**	**<25**	**25+**	**trend**
Women				
Economists and financial planner (091-099)				
Ca/Co	177/661	3/17	6/18	
OR (CI)	1.0	1.6 (0.4–6.4)	2.0 (0.7–5.8)	0.19
Textile worker (751-759)				
Ca/Co	160/625	11/22	15/49	
OR (CI)	1.0	2.3 (0.9–5.5)	1.1 (0.6–2.3)	0.47
Inspector and product analyst (961-964)				
Ca/Co	179/677	3/14	4/5	
OR (CI)	1.0	1.0 (0.3–4.0)	3.3 (0.7–15.2)	0.21

*Odds ratios adjusted for age, education, income, cigarette smoking, and other occupations. Ca = number of cases; Co = number of controls.

TABLE III. Odds Ratios (ORs) and 95% Confidence Intervals (CIs) for Pancreatic Cancer in Relation to Average Job Exposure to EMF Among Men and Women, Shanghai, China, 1990–1993*

	Men		Women	
JEM score[a]	**Case/control**	**OR (95% CI)**	**Case/control**	**OR (95% CI)**
Intensity				
None	125/414	1.0	111/398	1.0
Low	113/392	1.0 (0.7–1.4)	69/270	0.9 (0.6–1.4)
Medium	12/21	1.5 (0.6–3.7)	4/15	1.2 (0.4–3.7)
High	10/18	3.3 (1.4–7.9)	2/13	0.3 (0.04–2.8)
(*P* for trend)		$P = 0.05$		$P = 0.42$
Probability				
None	125/412	1.0	111/398	1.0
Low	100/346	1.0 (0.7–1.4)	62/249	0.9 (0.6–1.4)
Medium	20/59	0.8 (0.7–5.4)	10/24	1.2 (0.5–3.0)
High	15/28	2.6 (1.2–5.4)	3/25	0.3 (0.1–1.6)
(*P* for trend)		$P = 0.05$		$P = 0.36$

*Adjusted for age, education, income, cigarette smoking, and high-risk occupations.
[a]The score weighted by the method of job exposure matrix.

excesses were found among women because of the small number of female cases who were electrical and electronic workers or exposed to high level of EMF. Electrical or electronic worker was the most frequent job category among those with high intensity of EMF exposure (24 of 28 exposed men and 14 of 15 exposed women had at least one job related to electrical or electronic work). A possible explanation for the increased risk among electricians may be related to EMF exposures, although other exposures related to electrical machinery manufacturing are possible, such as solvents, solder fumes, and cutting oils. Few previous studies have reported an elevated risk of pancreatic cancer for electrical workers. One epidemiologic study based on a cancer surveillance data in Los Angeles has shown an excess risk for workers in electrical machinery equipment manufactory industries cross over both men and women [Mack and Paganini-Hill, 1981]. The incidence ratios of observed cases to the expected cases were 167 for white men and 216 for white women among workers in electrical machinery equipment manufactory industries. Another mortality study in Illinois showed that a 4-fold excess in risk was related to electric light and power, utilities, sanitary services and manufacturing, electrical machinery equipment and supplies among white men, and no data were available for women in this study [Mallin et al., 1986]. A historical cohort mortality study conducted in Canada had an excess mortality from pancreatic cancer among male workers employed at a transformer manufacturing plant, with over 7-fold excess of SMR among those who worked with this job for more than 6 months [Yassi et al., 1994]. The excess incidence also was found among electrical workers in another cohort study in Norway [Tynes et al., 1992]. The standardized incidence ratio for pancreatic cancer was 1.19 among electrical workers, and only male data were available in this study. A small risk (RR = 1.3) was detected among electric light and power industry employees in the U.S. veterans cohort

[Hrubec et al., 1995], but no other cohort studies found positive associations with exposures related to electrical workers Törnqvist et al., 1986; Baris et al., 1996].

We do not know if EMF exposure is responsible for the observed excess pancreatic cancer risk among electrical workers. EMF exposure has been hypothesized to alter normal removal or repair of cells with damaged DNA; to alter nervous system functioning, which influences the effect of stress or hormone release; and to alter the electrical concomitants of cellular growth and differentiation [Wertheimer and Leeper, 1982]. More recently, it has been suggested that exposure to EMF may suppress pineal gland production of melatonin, thereby promoting the occurrence of cancers [Stevens et al., 1992; Stevens, 1987]. EMF, however, has not been conclusively linked to any malignancy.

The increased risks for metal workers and toolmakers among men in our study were consistent with findings from some previous epidemiologic studies [Milham, 1976; Maruchi et al., 1979; Silverstein et al., 1988; Mallin et al., 1989; Siemiatycki et al., 1991], but not all [Pickle and Gottlieb, 1980; Mack et al., 1985]. Metal workers and toolmakers are exposed to a variety of potentially carcinogenic agents, including mineral oil, solvents, and metals [Kauppinen et al., 1995]. Whether the excesses in risk of glass manufacturers, potters, painters, and construction workers were related to exposures to silica dusts, asbestos, or other industrial dusts is not known [Falk et al., 1990; Milham, 1983]. The elevated risk seen for plumbing and welding workers may be related to the exposure to polycyclic aromatic hydrocarbons or other aromatic amines [Mastrangelo et al., 1996]. An observed doubling of risk experienced by cooks is consistent with previous reports of risk in food-related industries [Magnani et al., 1987; Pietri et al., 1990; Siemiatycki et al., 1991]. We did not find consistent results for those occupations among women because of the small number of cases that were in those occupations.

In the present study, textile workers experienced a 40% excess among women but not among men due to a lack of number of observations. Similar findings have been reported in other epidemiologic studies [Olsen and Jensen, 1987; Magnani et al., 1987; Pietri et al., 1990; Partanen et al., 1994]. The latest update on occupational mortality in Washington State [Milham, 1983] found a threefold increase in pancreatic cancer mortality in both male and female fabric workers under age 65, based on 11 cases in this occupational category. Others have speculated that this excess may be related to exposure to spinning oils or textile dusts [Falk et al., 1990]. A marginally significant increase in risk also was observed for economists and financial planners among women in our study. Because exposure to recognized carcinogenic agents is unlikely in these jobs, it is likely that these increases were due to chance or lifestyle factors.

Like other case-control studies, our study had several weaknesses. First, a major concern was the small number of subjects in most occupational groups. Second, recall bias may have been operating and both differential and non-differential errors may have occurred. Third, we did not attempt to validate job histories. Others have found about 70% concordance between reports of usual employment and company records [Bond et al., 1988]. Fourth, interviews in 39% of cases and 11% controls were assisted by next of kin. Findings, however, were consistent when the subjects with next-of-kin interviews were excluded from the analysis. Fifth, because of the advanced stage at diagnosis, only 57% of cases had histologic confirmation or surgery, with the remaining 43% diagnosed by CT scan and/or ultrasound. Our findings were not affected by the diagnostic status of cases, however.

In conclusion, this population-based case-control study of pancreatic cancer in Shanghai suggests that electricians may have an increased risk. This may be a chance finding or it may have been due to EMF or other exposures. Further studies on the relationship between electrical work and pancreatic cancer risk are warranted. Elevated risks also were associated with employment as a metal worker; toolmaker; plumbing and welding worker; and glass former, potter, painter, and construction worker among men; and textile worker among women. Additional research is needed to confirm these findings and to identify the occupational exposures responsible for the observed elevations in risk of pancreatic cancer.

REFERENCES

Anderson KE, Potter JD, Mack TM. 1996. Pancreatic cancer. In: Schottenfeld D, Fraumeni JF, editors. Cancer epidemiology and prevention. New York: Oxford University Press.

Baris D, Armstrong BG, Deadman J, Thériault G. 1996. A mortality study of electrical utility workers in Quebec. Occup Environ Med 53: 25–31.

Bond GG, Bodner KM, Sobel W, Shellenberger RJ, Flores GH. 1988. Validation of work histories obtained from interviews. Am J Epidemiol 128: 343–351.

Dosemeci M, Stewart PA, Blair A. 1989. Evaluating occupation and industry separately to assess exposures in case-control studies. Appl Ind Hyg 4: 256–259.

Falk RT, Pickle LW, Fontham ET, Correa P, Morse A, Chen V, Fraumeni JF Jr. 1990. Occupation and pancreatic cancer risk in Louisiana. Am J Ind Med 18: 565–576.

Howe GR, Jain M, Burch JD, Miller AB. 1991. Cigarette smoking and cancer of the pancreas: evidence from a population-based case-control study in Toronto, Canada. Int J Cancer 47: 323–328.

Hrubec Z, Blair AE, Vaught J. 1995. Mortality risk by industry among US veterans of known smoking status. Bethesda, MD: National Institutes of Health, NIH Publication No. 95–2747.

IARC. 1986. Tobacco smoking. Lyon, France: IARC, IARC Monogr Eval Carcinog Risk Chem Humans, Vol. 38.

Ji BT, Chow WH, McLaughlin JK, Benichou J, Hatch MC, Gao YT, Fraumeni JF Jr. 1995a. Cigarette smoking and alcohol consumption and the risk of pancreatic cancer: a casecontrol study in Shanghai, China. Cancer Causes Control 6:369–376.

Ji BT, Chow WH, Gridley G, McLaughlin JK, Dai Q, Wacholder S, Hatch MC, Gao YT, Fraumeni JF Jr. 1995b. Dietary factors and the risk of pancreatic cancer: a casecontrol study in Shanghai, China. Cancer Epidemiol Biomark Prev 4: 885–893.

Ji BT, Hatch MC, Chow WH, McLaughlin JK, Dai Q, Howe GR, Gao YT, Fraumeni JF Jr. 1996. Anthropometric and reproductive factors and the risk of pancreatic cancer: a casecontrol study in Shanghai, China. Int J Cancer 66:432–437.

Kauppinen T, Partanen T, Degerth R, Ojajarvi A. 1995. Pancreatic cancer and occupational exposures. Epidemiology 6:498–502.

Mack TM, Paganini-Hill A. 1981. Epidemiology of pancreas cancer in Los Angeles. Cancer 47:1474–1483.

Mack TM, Peters JM, Yu MC, Hanisch R, Wright WE, Henderson BE. 1985. Pancreas cancer is unrelated to the workplace in Los Angeles. Am J Ind Med 7: 253–266.

Magnani C, Coggon D, Osmond C, Acheson ED. 1987. Occupation and five cancers: a case-control study using death certificates. Br J Ind Med 44: 769–776.

Mallin K, Berkeley L, Young Q. 1986. A proportinal mortality of workers in a construction equipment and diesel engine manufacturing plant. Am J Ind Med 10:127–141.

Mallin K, Rubin M, Joo E. 1989. Occupational cancer mortality in Illinois white and black males, 19791984, for seven cancer sites. Am J Ind Med 15: 699–717.

Maruchi N, Brain D, Ludwig J, Elveback LR, Kurland LT. 1979. Cancer of the pancreas in Olmstead County, Minnesota, 1935–1974. Mayo Clin Proc 54: 245–49.

Mastrangelo G, Fadda E, Marzia V. 1996. Polycyclic aromatic hydrocarbons and cancer in man. Environ Health Perspect 104:1166–1170.

Milham S. 1976. Cancer mortality patterns associated with exposure to metals. Ann NY Acad Sci 271: 243–249.

Milham S Jr. 1983. Occupational mortality in Washington State 1950–1979. Washington, DC: US NIOSH Pub No. 83–116.

National Bureau of Statistics. 1982. General Administration of National Standards. Office of the National Census of the State Council. Standard Classification of Industries and Occupations Used for the Third National Census, Beijing, China.

Olsen JH, Jensen OM. 1987. Occupation and risk of cancer in Denmark: an analysis of 93,810 cancer cases, 1970–1979. Scand J Work Environ Health 13(Suppl):791.

Partanen T, Kauppinen T, Degerth R, Moneta G, Mearelli I, Ojajarvi A, Hernberg S, Koskinen H, Pukkala E. 1994. Pancreatic cancer in industrial branches and occupations in Finland. Am J Ind Med 25: 851–866.

Pickle LW, Gottlieb MS. 1980. Pancreatic cancer mortality in Louisiana. Am J Public Health 70: 256–259.

Pietri F, Clavel F, Auquier A, Flamant R. 1990. Occupational risk factors for cancer of the pancreas: a case-control study. Br J Ind Med 47:425–428.

Pietri F, Clavel F. 1991. Occupational exposure and cancer of the pancreas: a review. Br J Ind Med 48: 583–587.

Siemiatycki J, Gerin M, Dewar R, Nadon L, Lakhani R, Begin D, Richardson L. 1991. Associations between occupational circumstances and cancer. In: Siemiatycki J, editor. Risk factors for cancer in the workplace. Boca Raton: CRC Press, 142–145.

Silverman DT, Dunn JA, Hoover RN, Schiffman M, Lillemoe KD, Schoenberg JB, Brown LM, Greenberg RS, Hayes RB, Swanson GM, Wacholder S, Schwartz AG, Liff JM, Pottern LM. 1994. Cigarette smoking and pancreas cancer: a casecontrol study based on direct interviews. J Natl Cancer Inst 86:1510–1516.

Silverstein M, Park R, Marmor M, Maizlish N, Mirer F. 1988. Mortality among bearing plant workers exposed to metalworking fluids and abrasives. J Occup Med 30: 706–714.

Stevens RG. 1987. Electric power use and breast cancer: a hypothesis. Am J Epidemiol 125: 556–561.

Stevens RG, Davis S, Thomas DB, Anderson LE, Wilson BW. 1992. Electric power, pineal function, and the risk of breast cancer. FASEB J 6:853–860.

Törnqvist S, Norell S, Ahlbom A, Knave A. 1986. Cancer in the electric power industry. Br J Ind Med 43: 212–213.

Tynes T, Andersen A, Langmark F. 1992. Incidence of cancer in Norwegian workers potentially exposed to electromagnetic fields. Am J Epidemiol 136: 81–88.

Wertheimer N, Leeper E. 1982. Adult cancer related to electrical wires near the home. Int J Epidemiol 11:345–355.

Yassi A, Tate R, Fish D. 1994. Cancer mortality in workers employed at a transformer manufacturing plant. Am J Ind Med 25: 425–437.